7
Water sustainability of agribusiness activities in India

7.1 Local water challenges

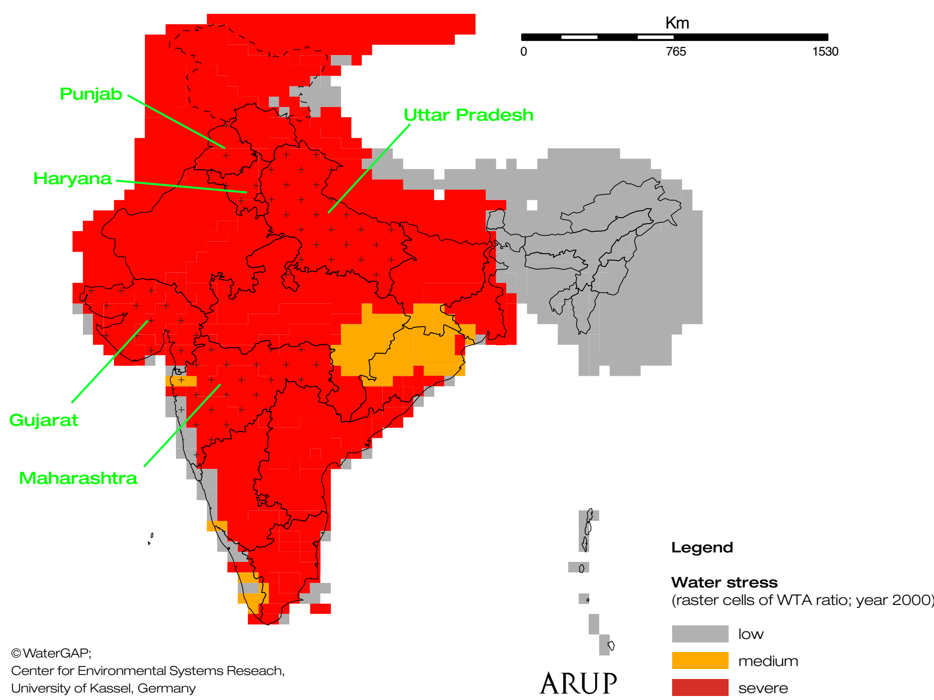
7.1.1 Water availability

Growing water scarcity is evident in India from falling groundwater tables and trends in river discharge. Uneven precipitation patterns, such as the South West Monsoon, compound water management challenges. For example, many areas experience localised, severe water shortages before the summer rains and are then subject to flooding during the monsoon. Water resource availability and exploitation across India are also highly variable due to climate and social factors. Circumstances in the semi-arid west are, for instance, very different to those in the wetter eastern areas.

Figure 6 shows that river basins across India are water stressed with the exception of areas in eastern India and isolated pockets in the South West.

Figure 6

Location of selected states of agricultural importance (labelled in green) and overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across India.

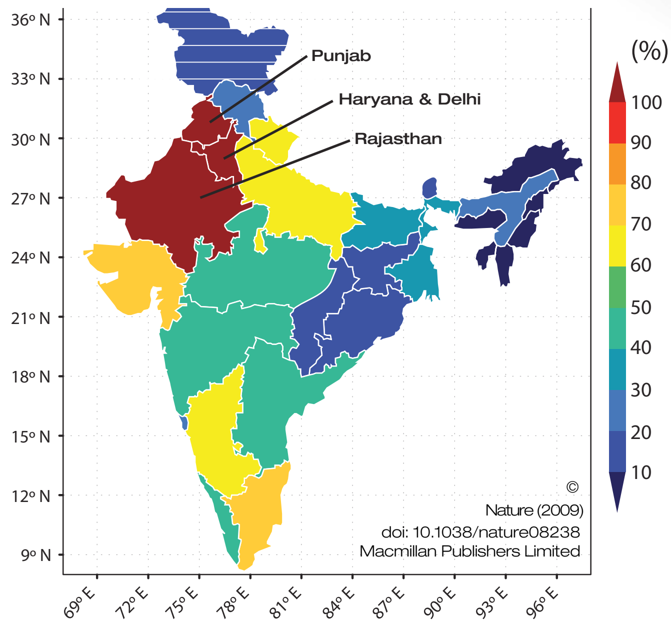


Water use in India is often unsustainable; the most significant cause is the overexploitation of groundwater resources, illustrated in Figure 7. These groundwater resources underpin irrigated agriculture across India, including the agriculturally significant states of Punjab and Haryana. The use of these underground reserves is growing rapidly as farmers turn to pumped wells to provide 'on-demand' irrigation in lieu of declining surface water supplies.[24] **It is and will be increasingly important for farmers and their financial backers to ensure sufficient availability and sustainable use of groundwater resources in the future, many of which are currently at risk of collapse.**

See Pls 3 & 12

Figure 7

Groundwater withdrawals as a percentage of recharge. The map is based on state-level estimates of annual withdrawals and recharge as reported by the Indian Ministry of Water Resources.[25,26]



7.1.2 Climate change impacts

By 2050, freshwater availability, particularly in large river basins, is projected to decrease. Studies indicate that, on average, India will reach a state of water stress before 2025 when overall water availability is projected to fall below 1'000 m^3 per capita.[27] Availability of freshwater will further decrease as a result of the continued shrinking or complete disappearance of Himalayan glaciers and the discontinuation of their critical function: the storage of water and its gradual and uniform release over long and potentially dry periods of time.

7.1.3 Water quality

Deteriorating water quality, resulting primarily from untreated industrial, domestic effluent, and municipal pollution, limits available water supplies. Naturally occurring water quality issues further exacerbate the problem; high fluorine in Rajasthan and arsenic content in West Bengal are cases in point. Salt-water intrusion into coastal aquifers affects yield and farmers'/agribusiness' operations that solely depend on coastal aquifers may be disadvantaged. Further, farming activities themselves may cause irrigation salinity through water table rise from irrigation systems.

A localised but growing problem in India is water-logging (the saturation of soils with water), which is well documented in large-scale irrigation schemes. It is normally found in areas close to unlined canals where surface water seeps from the canal into adjacent agricultural land. In Punjab, this issue has already caused significant losses in agricultural land.

See PIs 3 & 8

By asking the right questions, financial institutions can play a role in lessening the exposure of clients to polluted water as well as lessening the negative impacts of clients on the quality of natural water resources.

7.1.4 Institutional/regulatory context

Water resources are traditionally managed at the state level; however, the Ministry of Water Resources is responsible for policy guidelines and regulation of water at the federal level. In India, the use, management and ownership of water is often linked to land or irrigation structures, rather than to the resource itself; hence property rights to water are poorly defined.[28] This lack of clarity contributes to the complexity and high cost of legal disputes over water. There is growing recognition that these laws need to be amended and international attention is beginning to focus on this issue.

7.1.4.1 Groundwater exploitation

A critical element in India's growing water scarcity is the proliferation of tube-wells for irrigation. Groundwater development is unregulated and often instigated by the farmers themselves or through institutional finance. **It can be considered as in the highest interest of financial institutions to ensure the sustainable exploitation of ground water resources by farms and other actors.**

See PIs 3 & 11; Figure 7

7.1.5 Transboundary water management

India has a number of transboundary rivers and shares water with Pakistan, Bangladesh and Nepal. The water-sharing agreements between these countries, particularly with Pakistan, can be a source of tension. Inter-state water conflicts are also prevalent due to the federal system in India and are exacerbated by uncertain rights to water at the State level. A notable example is the dispute between Tamil Nadu and Karnataka over the Cauvery River.

7.2 Water use in irrigated agriculture: wheat, cotton, sugarcane and rice

7.2.1 The agricultural sector

India's agricultural sector is dominated by small, marginal holdings with generally low levels of mechanisation. Over 80% of farmers have holdings of less than 2 hectares, which account for 44% of the total holdings, yet these generate over 50% of agricultural output.[29]

Approximately one-third of agriculture is irrigated, with the highest levels of irrigation development located in the states of Punjab and Haryana, which unsurprisingly belong to the group of states with the highest and therefore most unsustainable levels of groundwater withdrawals. **Levels of irrigation efficiency are relatively low and improvements can be achieved by adequately designing, installing, and maintaining irrigation systems.**

See PIs 4, 6 & 11

Inadequate attention has been given to the maintenance of irrigation schemes resulting in the poor performance of these systems. Recent trends towards Participatory Irrigation Management and Water Users' Associations have transferred some of the responsibility for maintenance to farmers themselves, but the results from this policy change have been mixed.[30]

Irrigation and drainage systems are frequently unable to receive and deliver the needed quantity of water. This deterioration, combined with poor management of irrigation supplies – for example, a surplus of water above crop requirements – results in low efficiency levels. **Financial institutions are in a position to enhance the irrigation know-how of clients through the promotion of corresponding training activities; attention should also be paid to the condition of the water infrastructure that clients rely on.**

See PIs 2 & 4

7.2.2 Sources of irrigation water

The greater part of irrigation water in India is sourced from groundwater (wells), with the remainder sourced from canal networks fed by dams or tanks that collect rainwater during the monsoon. A recent analysis[31] of irrigation supplies in India showed that wells provide 61% of the supplied water, canals 29%, tanks 5% and other sources 5%. This dependence on groundwater leaves the agricultural sector vulnerable to falling groundwater tables and the deteriorating quality of these resources. The use of alternative and 'sustainable' sources of water such as water re-use and rainwater harvesting appears to remain well below potential levels, especially in light of particularly uneven rainfall patterns throughout most of India. **From a financial perspective, an increase in the exploitation of alternative resources can have positive impacts on the cost structure and the drought resilience of farms and other agribusiness operations.**

See PI 9

7.2.3 Sugarcane

The sugarcane belts of Uttar Pradesh and Maharashtra are the most significant sugarcane regions, followed by Tamil Nadu and Karnataka. Uttar Pradesh produces more than 40% of sugarcane in India. Here, much of the sugarcane is irrigated by groundwater and, therefore, declining water tables (depths of >20 m) have negative impacts on farm performance.

See PIs 3 & 11

The water productivity of sugarcane in India is about 60-70 m^3/t cane produced under controlled water management, and approximately 90% of the sugarcane production is irrigated. Water supply has a significant impact on cane productivity and profitability. Water is also required for processing. **By asking the right questions, financial institutions can play a role in increasing the crop-specific water productivity of clients.**

See PI 10

Substantial water productivity gains of 70 to 210% can be especially achieved by shifting from conventional surface to drip irrigation.[32] **Financial institutions can contribute to such shifts towards water-efficient technologies.**

See PI 6

Highly productive sugarcane areas (exceeding 80 t/ha in Maharashtra, Tamil Nadu and Karnataka for instance) are reliant on agro-chemicals (fertilizers, pesticides, and fungicides) that can seep to surface or groundwater sources if not properly applied.

See PIs 2 & 8

7.2.4 Cereals (wheat)

The states of Punjab and Haryana situated in the North-West of India are regarded as the most important agricultural areas in the country. Irrigation development here is above 80%, and agriculture is characterised by highly intensive inputs of energy, water and fertilisers. The most important crops in the region are wheat and rice. **Falling groundwater tables represent the most significant water risk for agribusiness**: over 75% of the state of Punjab, for instance, is subject to falling water tables.[34]

See PIs 3 & 11; Figure 7

The low level of investments into the maintenance of water infrastructure and efficiency improvements remains a significant concern. Insufficient water supply and the unsuitable timing of irrigation can substantially reduce yields, leading to low profitability at the farm level. Expertise on when to apply water, and on how to manage other inputs such as fertilisers, and pesticides is essential in maximising water productivity levels. **Financial institutions should therefore insist on capacity building and training of farmers on, soil-, water- and agrochemicals management.**

See PI 2

Current wheat production has low yields in the range of 1-2 t/ha on average across India, but yields in Haryana and Punjab by far exceed the average.[35,36,37] In this context, water productivity and yield levels are closely interlinked. **Improved yield levels can be achieved if water productivity levels are increased.** At an overall yield level of 1-2 t/ha, water requirements range between 3000 and 1700 m^3/t produced. When reaching a yield level of 4 t/ha, water productivity improves to 900 to 800 m^3/t.

See PI 10

7.2.5 Cotton

Significant areas for the production of cotton are the states of Gujarat, Maharashtra and Punjab. In Gujarat, over 40% of cultivated land is irrigated, particularly in the arid north, by schemes such as the Sardar Sarovar Dam Project. Here, as in many other parts of India, the growth in agriculture has been triggered by an explosive increase in groundwater-withdrawals (see Figure 7) and the introduction of high-yielding varieties, such as transgenic Bt cotton. Cotton output[38] has risen from 3 million bales (of 0.17 t each) in 2002/03 to 11 million bales in 2007/08.

In light of tightening water availability and increasing demand, financial institutions should continually review crop choice and the impacts of agribusiness operations on water resources.

See PIs 3, 5 & 11

7.2.6 Rice

In 2007, rice yields in India were greatest in Punjab, Andhra Pradesh and Haryana (6.0, 5.0 and 5.0 t/ha respectively).[39] Approximately 50% of the total area used for rice production in India is irrigated paddy (rice). However, paddy rice production ultimately relies on rainfall and in periods of low rainfall (e.g. monsoon failure), irrigation inputs are required.

See PI 5

In addition to paddy, other methods with alternate wet-dry rice are increasingly being promoted due to competing water demands. **Financial institutions can ensure the appropriateness of crops relative to local water conditions.**

See PI 10

Although rice yields have increased substantially since 1960, there are still several states that have low yield and water productivity levels. There are significant potentials to improve yields and increase water productivity.

Case study 2

Water savings from drip irrigation in Maharashtra

Irrigated agriculture in Maharashtra uses 70-80% of available water resources in the state. The state government has been very successful in promoting drip irrigation techniques. The reasons are varied and include: the large size of the plots used for cotton and sugarcane framing, the returns that farmers make from these cash crops (allowing greater investment), and the erratic rainfall patterns that make drip irrigation desirable.

The government has actively supported drip irrigation and as a result, a large number of manufacturers of drip systems have based themselves in the region. It is the home, for instance, of Jain Irrigation Systems, India's leading manufacturer, with facilities in the Jain hills that include a training centre for farmers, a demonstration plot and research laboratories. Availability of drip systems and awareness about the benefits of their use are more widespread here than elsewhere in India.

Sweet smell of success

Following the installation of drip irrigation systems in Maharashtra, sugarcane yield has more than doubled while the water and power intensities of production have significantly decreased.

This was also the experience of the 235 farmers of the Sri Vasant Dada Irrigation Society in Sangli who spent Rs 5.4 million to install drip irrigation facilities in 179 ha of their sugarcane plantations.

The upfront financing of approximately Rs 2 million was extended by sugar companies in the form of credit. The farmers were able to repay the loan in just one year, as opposed to the usual payback period of five years. This was possible because of a yield increase due to resource efficiency improvements achieved through the installation of drip systems.

The following table summarises the results:

Power consumed: Before	1.25 hp/acre
Power consumed: After	0.95 hp/acre
Water utilisation efficiency: Before	50 – 60%
Water utilisation efficiency: After	90 – 95%
Seed germination: Before	60 – 65%
Seed germination: After	90 – 95%

Modified from "Down To Earth" supplement (2003) on "More crop per drop" [33]

7.3 Performance indicators

Based on the current context of water challenges and agribusiness operations in India, 11 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations in the region.

	Description	Rationale and materiality
PI 1 **Does the client comply with existing environmental standards and/or is the client in a position to comply with regulation likely to emerge in the future?**	Environmental standards relevant to water sustainability are related to the pollution of water courses and the over-exploitation of water resources.	Breaching environmental standards and subsequent prosecution can incur financial costs and cause reputational damage as well as loss from litigation, both for the farm as well as the lender. On the contrary, agribusiness operations that already comply with environmental regulation which is likely to emerge in the future have a clear advantage relative to 'unprepared' peers.
PI 2 **Has the client participated in training on irrigation, pesticide management or integrated nutrient management?**	Training for farmers is provided in India either through the private sector (such as Jain Irrigation Systems) or through government training schemes such as Command Area Development Programmes.	• Training for farmers has been shown to increase irrigation efficiency and increase yields. • Correct nutrient and pesticide management can further reduce the application of these substances thereby reducing costs. • Efficient use of fertilisers and pesticides can prevent excess run-off of pollutants and contamination of water supplies and therefore prevent reputational damage and loss from litigation.
PI 3 **Has the client conducted an assessment of the security of sustainable water availability in both (a) quantitative as well as (b) qualitative terms?**	An assessment of sustainable water availability should address a number of factors including an assessment of the competing users. **(a) Quantitative security** ***General*** • Availability of water within the river basin; see Figure 6 on page 26. • Levels of storage capacity and load within the basin such as dams and tanks. • Alternative sources of supply (examples: rainwater harvesting, re-use of water, water trading) ***Groundwater*** Levels of ground water depletion as a percentage of annual recharge are shown in Figure 7. Information is also available from state governments at block and district levels. ***Surface water*** Reliability of surface water availability: for example, incidence of unforeseen canal closures; load and capacity levels of reservoirs, etc. **(b) Qualitative security** An assessment of sustainable water quality should include an assessment of salinity and pollution.	(a) Unreliable or uncertain water availability is a significant risk for agriculture. For example, in India, special caution should be taken if tube-well irrigation is proposed in areas where groundwater resources are documented as over-exploited (see Figure 7). (b) High levels of salinity can reduce crop yields. This is a growing area of concern in states such as Punjab where salinity has reduced the availability of water supply. Crops with low salt tolerance are damaged by irrigation with saline water.
PI 4 **Is local water infrastructure, such as canals, well maintained? Do farmers contribute to the maintenance of local irrigation infrastructure?**	Large irrigation infrastructure such as canals in Punjab and Haryana provide surface water to farmers. Maintenance of irrigation infrastructure is essential for the efficient operation of these systems. Canals and irrigation systems require regular maintenance to remove silt, weeds, debris, and also repair leaks. Low levels of cost recovery lead to declining funds for maintenance and exacerbate the poor provision of irrigation services.[40]	In order to operate effectively and efficiently, water infrastructure must be adequately maintained. Over recent years, the performance of canals has declined. Farm reliance on infrastructure, particularly if poorly maintained, can enhance the risk of failure of water supply in sufficient quantity and/or quality.

PI 5 **Has the client assessed whether the crops cultivated are appropriate to local hydrological conditions?**	Water resource conditions include local water availability, precipitation patterns, salinity levels as well as water and air temperature. Crops that are suitable for a specified environment can be identified using the FAO Ecocrop.[41]	Replacement of water-intensive crops with efficient and drought-resistant crops is a key opportunity; it can have positive effects on cost structure and business resilience over the medium to long term.
PI 6 **Does the client use best available water-efficient irrigation systems/ technologies?**	The use of drip and micro-sprinkler systems has been promoted for instance in Maharashtra. State governments often subsidise these schemes and encourage uptake of such technologies by farmers.	The use of efficient drip and micro-sprinkler/under canopy systems enhances irrigation efficiency relative to other conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.
PI 7 **Are both statutory as well as customary rights clearly established for access to water?** **Does the client hold specific water licences and entitlements to use the appropriate amount of water?**	Rights to water include abstraction rights, water rights and licenses under statutory law at the State level. Rights to water are also recognised in customary law, particularly with regard to the allocation of irrigation water, which may overlap with formal State water laws or run in parallel with them.[42]	Clearly established rights to water reduce risks to farmers; for example, established rights reduce the risk of contested water allocations and provide the basis for both formal and informal water trading schemes. [43] In order to minimise the risk of contested water rights with local communities, customary rights should be respected, in addition to statutory rights.
PI 8 **Which of the following practices to reduce environmental and water resource impacts have been adopted?**	Eco-friendly management techniques can prevent the early depletion of soil fertility and pollution of groundwater resources. Practices include: □ cost-reducing biological pest management □ high water efficiency in sugarcane processing: application of dry washing techniques (water use should be lower than 2 m^3/t of sugarcane) □ treatment of wastewater from crop processing □ application of slurry or sewage sludge in line with environmental standards □ triple rinse followed by appropriate deposition and disposal of agrochemicals containers □ no-tillage system (NTS) □ high degree of diversification of crop species or crop rotation □ periodic monitoring of soil through physical-chemical analysis □ prevention of soil erosion □ application of herbicides and pesticides with low water contamination and leaching potential	Eco-friendly agricultural practices can increase profitability through cost reductions, soil fertility recovery, and erosion mitigation, and attract new customers with increasingly sustainability-oriented consumption preferences.
PI 9 **Does the client access innovative sources of water supply: re-use of water, managed aquifer recharge and/or rainwater harvesting?**	India's overall water situation is characterized by overexploitation of groundwater resources and declining water tables. In addition to improvements in water productivity, more sustainable water sources should be explored and further exploited.	Farms and agribusiness operations over-dependent on water resources will be at a competitive disadvantage relative to those that diversify irrigation water sources to more sustainable alternatives. Increasing levels of water re-use as well as collecting and storing rainwater during the Monsoon period appear promising ways forward. The use of such sustainable sources can reduce the pressure on groundwater tables across the country.

PI 10 **What is the client's crop-specific water productivity performance?**	High levels of water productivity/efficiency may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turn-over. The level of water efficiency of a given operation will depend on a wide set of local parameters. National or regional averages can, therefore, only serve as rough proxies. Reference values Benchmark values of water productivity in India are: **Sugarcane** 70-60 m^3/ton **Wheat** For yield levels of 1-2 t/ha: 3000-1700 m^3/ton For yield levels of 4 t/ha: 900-800 m^3/ton **Cotton (for Haryana; year 1996)** Approx. 2100 m^3/ton **Rice (for Haryana; year 2003)** 2777-1500 m^3/ton	In addition to environmental benefits, high levels of water productivity/efficiency have positive impacts on the cost-structure and drought-resilience of agricultural activities.
PI 11 **Is the groundwater used by the client exploited in a sustainable manner? Does the client contribute to the conservation/sustainable use of groundwater resources?**	Figure 7 shows that groundwater withdrawals are unsustainable in many parts of India, often because groundwater development is unregulated and instigated by farmers themselves.	Clients depending on groundwater resources should ensure that own as well as collective withdrawals of groundwater resources are sustainable in the long term. If aquifers cease to supply sufficient quantities of water due to over-exploitation, agricultural activities will become unviable.

Notes :

* Water quality data is available from State Groundwater Boards; however there are complexities with regard to the application of this data, for example seasonal variations in water quality and the effects of averaging data.